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FLOOD INSURANCE STUDY

CITY OF COLONIAL HEIGHTS, VIRGINIA
INDEPENDENT CITY

OCTOBER 18, 1988

Federal Emergency Management Agency

COMMUNITY NUMBER - 510039

NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance study purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map

FLOOD INSURANCE STUDY
CITY OF COLONIAL HEIGHTS, VIRGINIA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Colonial Heights, Independent City, Virginia, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study represent a revision of the original analyses prepared by the Norfolk District of the U. S. Army Corps of Engineers (COE) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. IAA-H-18-78, Project Order No. 35. The work for the original study was completed in October 1979.

The hydrologic and hydraulic analyses for Old Town Creek in this revision were prepared by the Norfolk District of the COE under agreement with FEMA. This work was completed in July 1987.

1.3 Coordination

In December 1977, an initial Consultation and Coordination Officer's (CCO) meeting was held with representatives of FEMA, the city, and the COE (the study contractor) to discuss the streams to be studied by detailed methods. Results of the hydrologic analyses were coordinated with the State Water Control Board, the U. S. Geological Survey (USGS), the city, and FEMA. On September 17, 1980, a final CCO meeting was held with representatives of FEMA, the city, and the study contractor.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Colonial Heights, Independent City, Virginia. The area of study is shown on the Vicinity Map (Figure 1).

The following streams were studied by detailed methods: the Appomattox River, Swift Creek, and Old Town Creek. This revision incorporated an additional portion of Old Town Creek. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.

Fleets Branch, a tributary to the Appomattox River, was studied by approximate methods. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the City of Colonial Heights.

2.2 Community Description

The City of Colonial Heights is located in south-central Virginia, approximately 20 miles south of the City of Richmond and approximately 100 miles west of the City of Norfolk. Colonial Heights is bordered by the City of Petersburg to the south and the unincorporated areas of Chesterfield County to the west, north, and east. The total land area contained within the corporate limits is 8 square miles. In 1977, the population of Colonial Heights was estimated at 16,800 (Reference 1). The city is a component of the Petersburg-Colonial Heights Standard Metropolitan Statistical Area (SMSA).

Colonial Heights and the surrounding areas are rich in Virginia history, beginning with John Smith's exploration of the Appomattox River in 1607. The first recorded settlement in Colonial Heights was by Thomas Shore in 1775. The area grew and became a town in 1926 and an incorporated city in 1948. This area was the site of significant battles during both the American Revolution and the Civil War.

Colonial Heights is undergoing rapid development. Being located within commuting distance of Richmond, Petersburg, Hopewell, and Fort Lee, the area is prime for residential and commercial development. As the population increases, it will create a heavy demand for land not yet developed within Colonial Heights.

Colonial Heights is located along the Appomattox River approximately 6 miles above its confluence with the James River. The Appomattox River forms the southern and eastern boundary of the city and is

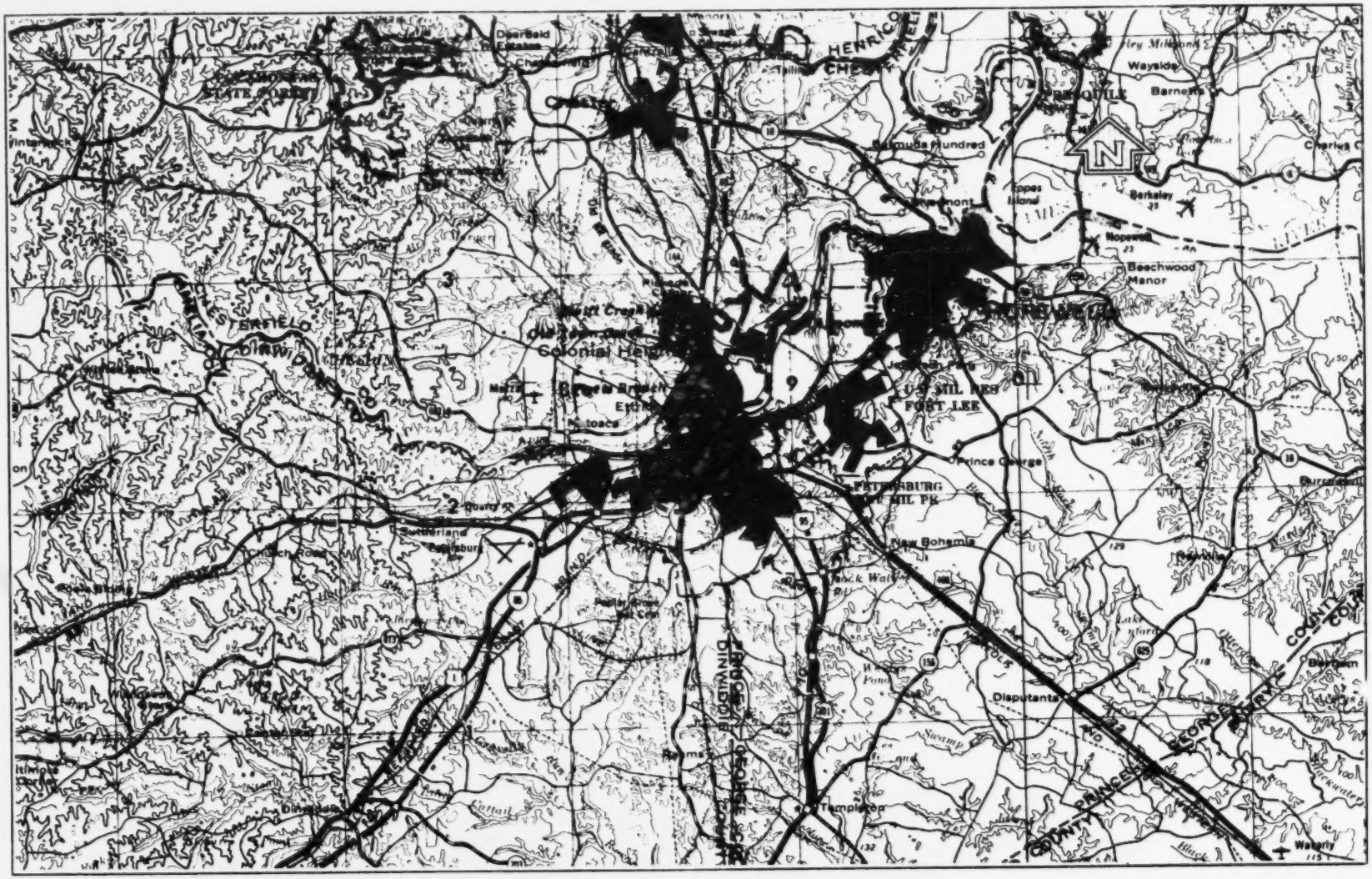


FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF COLONIAL HEIGHTS, VA
(INDEPENDENT CITY)

APPROXIMATE SCALE
4 0 4 8 12 MILES

VICINITY MAP

contributed to by a drainage area of approximately 1,365 square miles in the vicinity of Colonial Heights.

Swift Creek, a tributary to the Appomattox River, forms the northern boundary of the city. Swift Creek's watershed is generally rectangular in shape and measures approximately 30 miles long and 9 miles wide at its broadest points. It has a drainage area of 184 square miles.

Old Town Creek flows east to the Appomattox River. The creek's narrow watershed is approximately 7.5 miles long and has a drainage area of 13.5 square miles.

Colonial Heights is located in the fall zone, in the eastern escarpment of the Piedmont Plateau. Consequently, elevations within the city range from sea level to approximately 95 feet. Temperatures average 40 degrees Fahrenheit (^{o}F) in January and 78^{o}F in July. Annual precipitation averages approximately 40 inches and is fairly uniformly distributed throughout the year (Reference 2).

2.3 Principal Flood Problems

Colonial Heights, with its several watersheds, has experienced flooding in varying degrees, but with limited property damage. Tropical storms are responsible for some of the larger floods, particularly on the Appomattox River. The hydraulic and hydrologic nature of the Appomattox River drainage basin is such that when flooding occurs, it lasts for several days.

Floods may occur during any season of the year. Three of the five largest floods on the Appomattox River at Colonial Heights occurred in the period from October 1971 to October 1972, including the flood of record, which was attributable to Tropical Storm Agnes. The following tabulation shows the major past floods and the corresponding recurrence interval on the Appomattox River:

Date	Discharge (cfs)	Recurrence Interval (years)
October 1972	40,800	110
August 1940	28,000	40
June 1972	22,800	25
October 1971	21,100	20
April 1937	18,800	15

The lower portions of Swift Creek and Old Town Creek are subject to backwater effects from the James River and the Appomattox River, respectively. Flooding on these creeks may occur as a result of local thunderstorms or from large storm systems that also affect the James and Appomattox Rivers.

Damage from past floods along the Appomattox River in Colonial Heights has been minor due to the topography, physical characteristics and minimal development of the floodplain. However, this is not true along the Swift Creek and Old Town Creek floodplains where numerous residential structures have been constructed, thus creating the potential for major flood damage.

2.4 Flood Protection Measures

At the present time, there are no flood protection projects in Colonial Heights. There are, however, two dams on Swift Creek that are no longer in use: the Swift Creek Mill Dam, once used to supply water to the Swift Creek Mill; and the Filtration Plant Dam, once used to supply water to Colonial Heights. The reservoirs formed by these two structures have practically no flood control storage and would not significantly alter downstream flow characteristics during a large flood.

Non-structural flood protection measures are also being utilized to aid in the prevention of future flood damage. Section 873.5 of the Virginia Uniform Statewide Building Code controls building within areas that have a high risk of flooding (Reference 3).

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

Discharges for the streams studied in detail were developed in a series of Flood Plain Information reports previously prepared by the Norfolk District of the COE and two contiguous Flood Insurance Studies for the unincorporated areas of Prince George County and the City of Petersburg (References 4, 5, 6, 7, and 8).

For the Appomattox River, statistical analyses were made to determine the discharge-frequency curve. Records have been maintained on the Appomattox River near Colonial Heights since October 1926 except for the 3-year period of September 1966 to October 1969 when the Brasfield Dam was constructed (Reference 9). A discharge-frequency curve based on these records was developed according to Leo Beard's Statistical Methods in Hydrology and was used in the Flood Plain Information report for the Appomattox River (References 10 and 4). The discharge values from this study were reviewed using guidelines in Water Resources Council Bulletin 17 and adopted for use in this study (Reference 11).

Discharges for the ungaged streams, Swift Creek and Old Town Creek, were determined from unit-hydrographs. Based on hydraulic parameters (slope, length, drainage area, and time of concentration) determined for each stream, unit-graphs (using Clark's method) were developed for several locations on each stream. Rainfall-frequency values selected from Technical Paper No. 40 were applied to the unit-graphs to obtain the desired discharge frequencies (Reference 12).

A summary of the drainage area-peak discharge relationships for the flooding sources studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
APPOMATTOX RIVER					
At U. S. Route 1-301	1,365.0	16,100	30,000	40,000	76,000
SWIFT CREEK					
At confluence with Appomattox River	184.0	18,520	25,990	28,540	38,550
OLD TOWN CREEK					
At confluence with Appomattox River	13.5	4,500	5,860	6,770	8,860

Flood discharge for Fleets Branch, which was studied by approximate methods, were derived from regional relationships developed for streams in this area.

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross section and bridge data for the backwater analyses on the streams studied in detail were obtained from a series of floodplain information reports and Flood Insurance Studies for the unincorporated areas of Prince George County and the City of Petersburg (References 4, 5, 6, 7, and 8). Field checks were made for bridge modifications or additions since completion of the studies. In addition, on Swift Creek and Old Town Creek, surveyed cross sections were supplemented with sections taken from topographic maps (Reference 13).

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).

Channel roughness factors (Manning's "n") used in the hydraulic computations for the Appomattox River were determined from backwater computations made to reproduce profiles of past flooding. Roughness values for the main channels ranged from 0.035 to 0.070, and the floodplain roughness values ranged from 0.120 to 0.140. Roughness values for Swift Creek and Old Town Creek were assigned on the basis of field inspection of the floodplain areas and on previous studies conducted by the COE. For Swift Creek, values were 0.030 for the channel and 0.080 for the overbanks. The selected values for Old Town Creek were 0.065 for the channel and 0.080 for the overbanks areas.

Water-surface elevations of floods of the selected recurrence intervals were computed using the COE HEC-2 step-backwater computer program (Reference 14). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for the Appomattox River were taken from the Flood Insurance Study for the unincorporated areas of Prince George County (Reference 7). Starting water-surface elevations for Swift Creek and Old Town Creek were calculated using the slope/area method. In the course of computing water-surface elevations for Old Town Creek, the Seaboard Coast Line Railroad culvert controlled flows to the extent that storage-type analyses had to be used in this portion of the stream.

For the stream studied by approximate methods, the boundary of the 100-year flood was determined by slope/area computations. These computations were made for typical cross sections taken from topographic maps to establish average depth and width relationships (Reference 13).

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing floodplain management measures.

4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For the flooding sources studied in detail, the 100- and 500-year floodplain boundaries have been delineated using topographic maps (Reference 13).

For the stream studied by approximate methods, the 100-year flood boundary was developed from normal depth calculations, topographic maps, and the previous Flood Insurance Study for the City of Colonial Heights (References 13 and 15).

The 100- and 500-year floodplain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent

floodplain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the floodplain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

For a portion of Swift Creek, from its confluence with the Appomattox River upstream to Interstate Route 95, and portions of Old Town Creek, from its confluence with the Appomattox River to a point 6,650 feet upstream and from U. S. Route 1-301 to the upstream corporate limits, no floodway encroachment was attempted in accordance with a request by the community. In these areas, the floodway boundary is shown as the natural 100-year flood boundary.

As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year floodplain boundaries are either close together or collinear, only the floodway boundary has been shown. Portions of the floodway widths for the Appomattox River, Swift Creek, and Old Town Creek extend beyond the corporate limits.

The area between the floodway and 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 2 for certain downstream cross sections of Swift Creek and Old Town Creek are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.

5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH[3] (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Appomattox River								
A	6.62[1]	2865/210	25,596	1.6	8.5	8.5	9.2	0.7
B	7.21[1]	1809/210	17,217	2.4	8.9	8.9	9.5	0.6
C	7.66[1]	2043/ 25	18,601	2.2	9.2	9.2	9.8	0.6
D	8.28[1]	1801/ 20	17,827	2.3	9.9	9.9	10.4	0.5
E	9.03[1]	1029/ 30	11,756	3.5	10.8	10.8	11.2	0.4
F	9.67[1]	847/150	9,443	4.3	11.6	11.6	12.0	0.4
G	10.08[1]	532/210	6,134	4.1	12.5	12.5	13.2	0.7
H	10.88[1]	535/ 85	7,690	4.2	16.0	16.0	16.4	0.4
I	11.29[1]	341/ 75	5,920	5.4	19.3	19.3	19.7	0.4
J	11.76[1]	491/ 90	8,489	3.8	20.3	20.3	20.9	0.6
K	12.19[1]	630/165	8,639	4.6	21.2	21.2	21.8	0.6
Swift Creek								
A	6,165[2]	5495/120	25,160	1.1	8.3	7.4[4]	7.4	0.0
B	9,810[2]	1600/1485	11,230	2.6	8.9	8.9	8.9	0.0
C	12,375[2]	3100/850	22,180	1.3	13.0	13.0	13.2	0.2
D	15,840[2]	950/820	6,520	4.3	13.8	13.8	14.6	0.8
E	17,450[2]	700/490	6,660	4.2	16.1	16.1	16.7	0.6
F	22,650[2]	425/ 95	3,350	8.5	22.8	22.8	22.9	0.1

[1]Miles above mouth
[2]Feet above confluence with Appomattox River
[3]Width/width within corporate limits
[4]Elevation computed without consideration of backwater effects from James River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF COLONIAL HEIGHTS, VA
(INDEPENDENT CITY)

FLOODWAY DATA

APPOMATTOX RIVER AND SWIFT CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Swift Creek (continued)								
G	23,065	235/ 60[2]	2,790	10.3	26.1	26.1	26.1	0.0
H	25,160	300/215[2]	3,720	7.7	30.4	30.4	30.4	0.0
I	28,125	160	3,140	9.2	37.5	37.5	37.6	0.1
J	28,770	160	2,740	10.5	37.9	37.9	38.1	0.2
K	30,395	160	3,130	9.3	40.4	40.4	41.1	0.7
L	31,175	160	2,910	10.0	41.1	41.1	41.6	0.5
M	31,920	325	5,700	5.1	42.3	42.3	43.3	1.0
N	32,497	800	20,930	1.4	65.0	65.0	66.0	1.0
O	33,895	400	10,460	2.8	67.9	67.9	68.3	0.4
P	35,133	300	6,610	4.4	67.9	67.9	68.3	0.4
Old Town Creek								
A	865	1,485	5,535	1.2	11.1	7.8[3]	7.8	0.0
B	4,240	1,005	4,745	1.4	11.1	10.4[3]	10.4	0.0
C	5,220	1,410	6,760	1.0	11.1	10.7[3]	10.7	0.0
D	6,300	295	1,165	5.7	11.4	11.4	11.4	0.0
E	7,000	400	2,305	2.9	15.6	15.6	16.1	0.5
F	7,910	445	2,360	2.8	18.9	18.9	19.8	0.9

[1]Feet above confluence with Appomattox River
[2]Width/width within corporate limits
[3]Elevation computed without consideration of backwater effects from Appomattox River

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF COLONIAL HEIGHTS, VA
(INDEPENDENT CITY)

FLOODWAY DATA

SWIFT CREEK AND OLD TOWN CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
					(FEET NGVD)			
Old Town Creek (continued)								
G	8,820	525	3,020	2.2	22.1	22.1	22.8	0.7
H	9,470	235	1,805	3.6	24.1	24.1	24.9	0.8
I	10,200	200	1,895	3.5	27.0	27.0	27.6	0.6
J	10,610	500	3,015	2.2	28.1	28.1	29.0	0.9
K	11,220	700	1,610	4.1	30.3	30.3	31.2	0.9
L	12,050	350	3,610	1.8	39.0	39.0	39.0	0.0
M	12,800	400	2,890	2.2	39.4	39.4	39.6	0.2
N	13,690	450	2,670	2.4	40.9	40.9	41.5	0.6
O	14,000	400	1,770	3.6	41.8	41.3	42.6	0.8
P	14,400	210	1,106	5.9	44.8	44.8	45.8	1.0
Q	14,931	860	3,965	1.6	53.6	53.6	53.6	0.0
R	15,380	710	2,671	1.8	53.9	53.9	54.1	0.2
S	16,065	80	766	4.0	54.1	54.1	54.5	0.4
T	16,430	1260/725[2]	15,251	0.4	67.7	67.7	67.7	0.0
U	17,190	814/465[2]	9,395	0.7	67.7	67.7	67.7	0.0
V	18,540	325/255[2]	3,485	1.8	68.0	68.0	68.0	0.0
W	19,430	515/415[2]	4,000	1.6	69.1	69.1	69.1	0.0

[1]Feet above confluence with Appomattox River
[2]Width/width within corporate limits

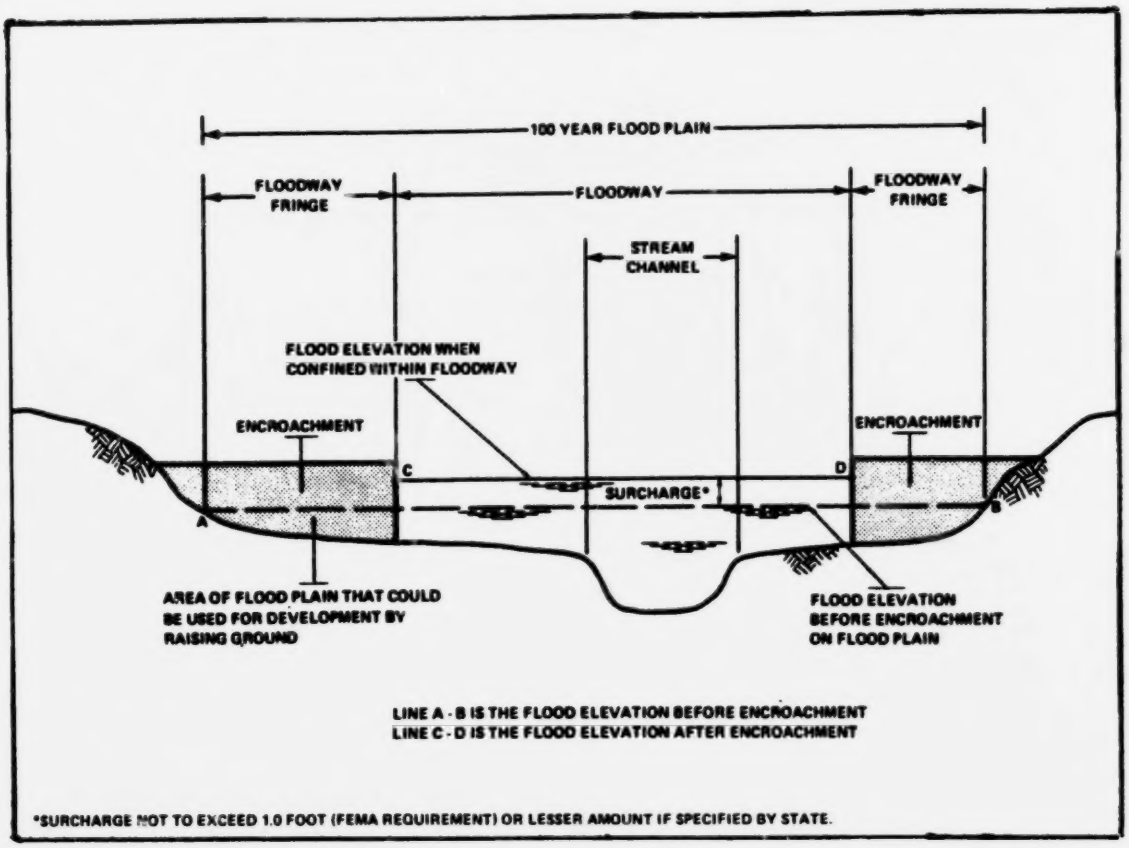
TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF COLONIAL HEIGHTS, VA
(INDEPENDENT CITY)

FLOODWAY DATA

OLD TOWN CREEK


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

Floodway Schematic - Figure 2

zone designations for each flooding source studied in detail in the City of Colonial Heights.

5.1 Reach Determinations

Reaches are defined as sections of floodplain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following tabulation for more than 20 percent of the reach:

Average Difference Between 10- and 100-Year Floods	Variation
Less than 2 feet	0.5 foot
2 to 7 feet	1.0 foot
7.1 to 12 feet	2.0 feet
More than 12 feet	3.0 feet

The locations of the reaches determined for the flooding sources of the City of Colonial Heights are shown on the Flood Profiles (Exhibit 1) and summarized in Table 3.

5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one- half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined.
Zones A2, A3, A4, A5, A8, and A13:	Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs.
Zone B:	Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.
Zone C:	Areas of minimal flooding; not subdivided.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Appomattox River							
Reach 1	01, 03	-2.4	-1.1	+4.1	025	A5	Varies
Reach 2	03, 04	-4.2	-1.3	+4.2	040	A8	Varies
Reach 3	04	-6.4	-2.1	+3.7	065	A13	Varies
Swift Creek							
Reach 1	01,02,03	-2.4	-0.7	+2.3	025	A5	Varies
Old Town Creek							
Reach 1	03	-1.0	-0.4	+0.8	010	A2	Varies
Reach 2	02, 03	-1.7	-0.5	+0.8	015	A3	Varies
James River (Backwater area affecting Appomattox River and Swift Creek)	01	-1.8	-0.6	+4.1	020	A4	8.3

[1]Flood Insurance Rate Map Panel
[2]Weighted Average
[3]Rounded to the nearest foot - see map

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF COLONIAL HEIGHTS, VA
(INDEPENDENT CITY)

FLOOD INSURANCE ZONE DATA

APPOMATTOX RIVER, SWIFT CREEK, OLD TOWN CREEK, AND JAMES RIVER

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the community are shown in Table 3.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Colonial Heights is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

6.0 OTHER STUDIES

Flood Plain Information reports have been prepared for the Appomattox River, Swift Creek, and Old Town Creek by the COE (References 4, 5, and 6).

Flood Insurance Studies have been published for the unincorporated areas of Prince George County and the City of Petersburg (References 7 and 8). Due to the scope of this revision, those studies were not rechecked for agreement with this study. Based on the results of the previous studies, this study is assumed to be in agreement with those studies.

Due to its more up-to-date information, this study supersedes the previous Flood Insurance Study for the City of Colonial Heights (Reference 15).

7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting FEMA, the Natural and Technological Hazards Division, Liberty Square Building (Second Floor), 105 South Seventh Street, Philadelphia, Pennsylvania 19106.

8.0 BIBLIOGRAPHY AND REFERENCES

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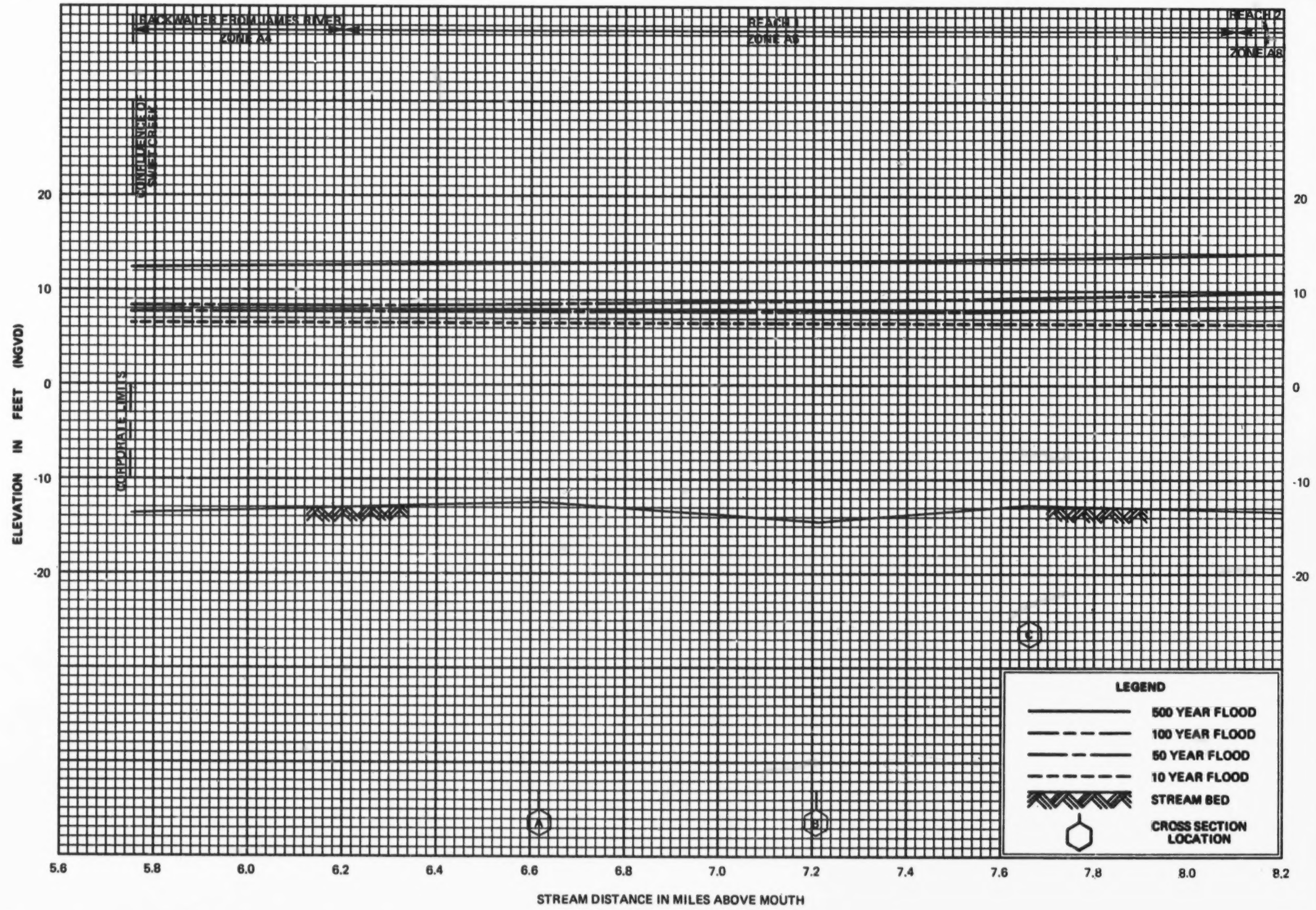


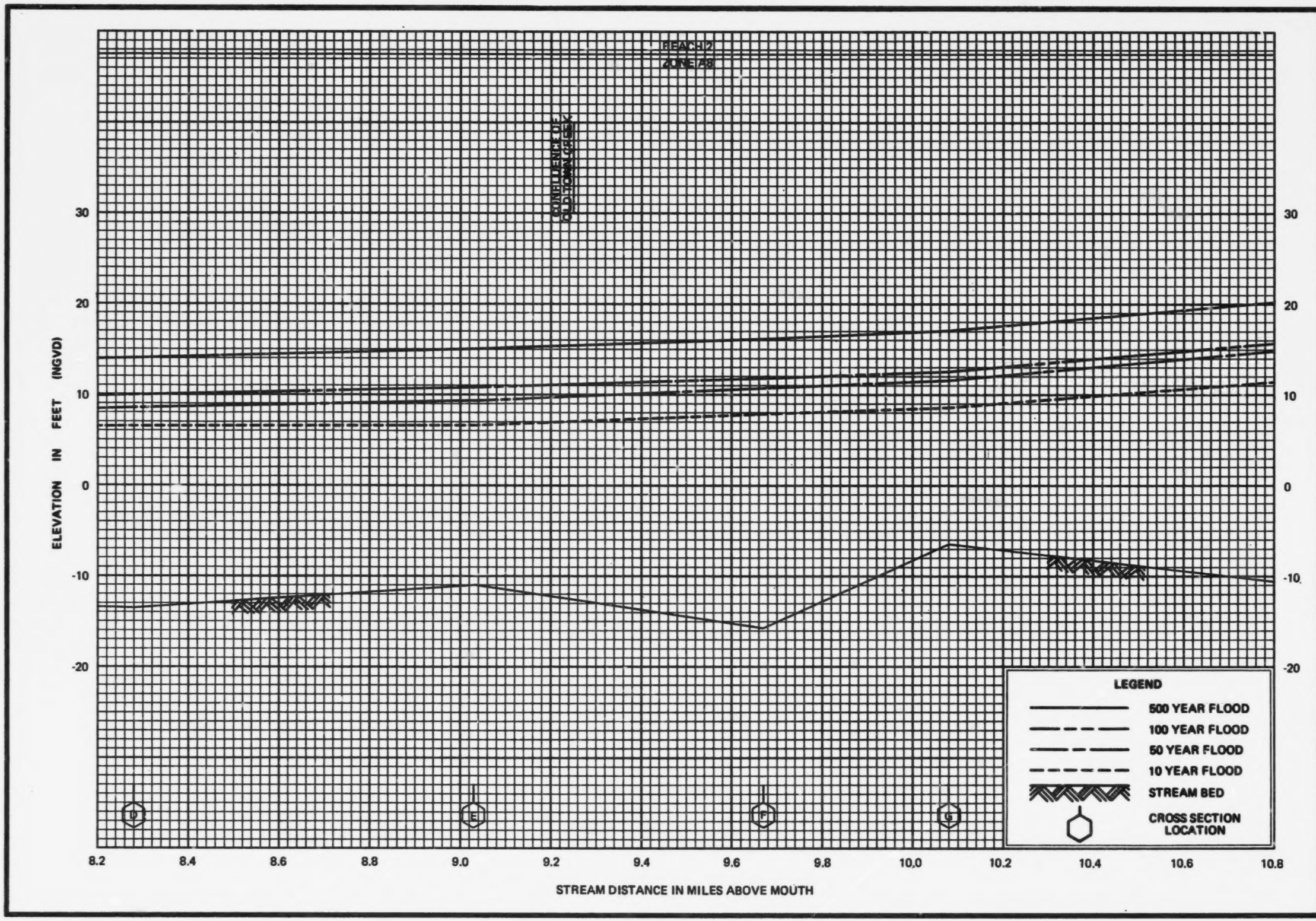
FLOOD PROFILES

APPOMATTOX RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF COLONIAL HEIGHTS, VA
(INDEPENDENT CITY)

01P



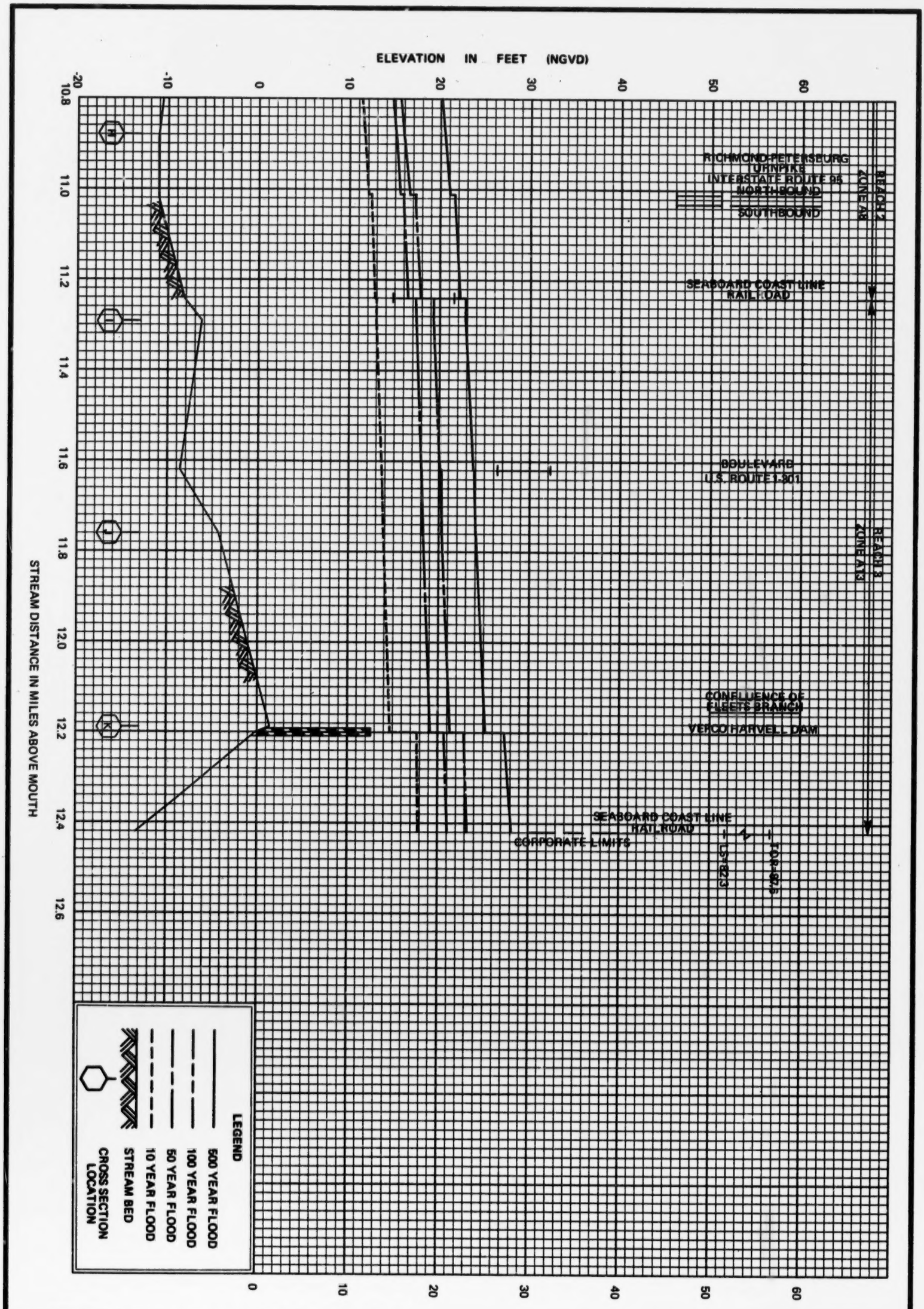
FLOOD PROFILES

APPOMATTOX RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF COLONIAL HEIGHTS, VA
(INDEPENDENT CITY)

02P



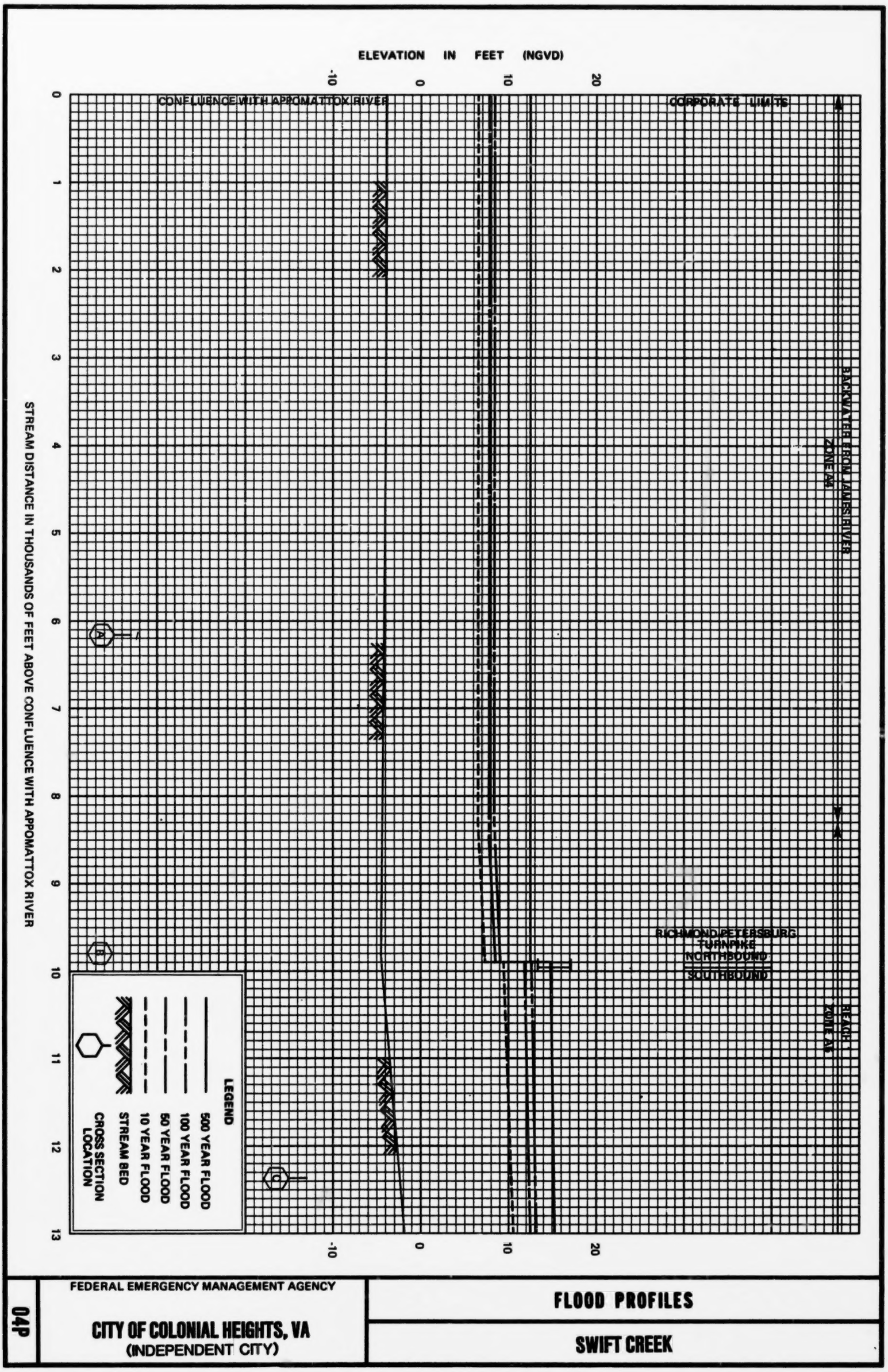
FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF COLONIAL HEIGHTS, VA
(INDEPENDENT CITY)

FLOOD PROFILES

APPOMATTOX RIVER

03P



FEDERAL EMERGENCY MANAGEMENT AGENCY

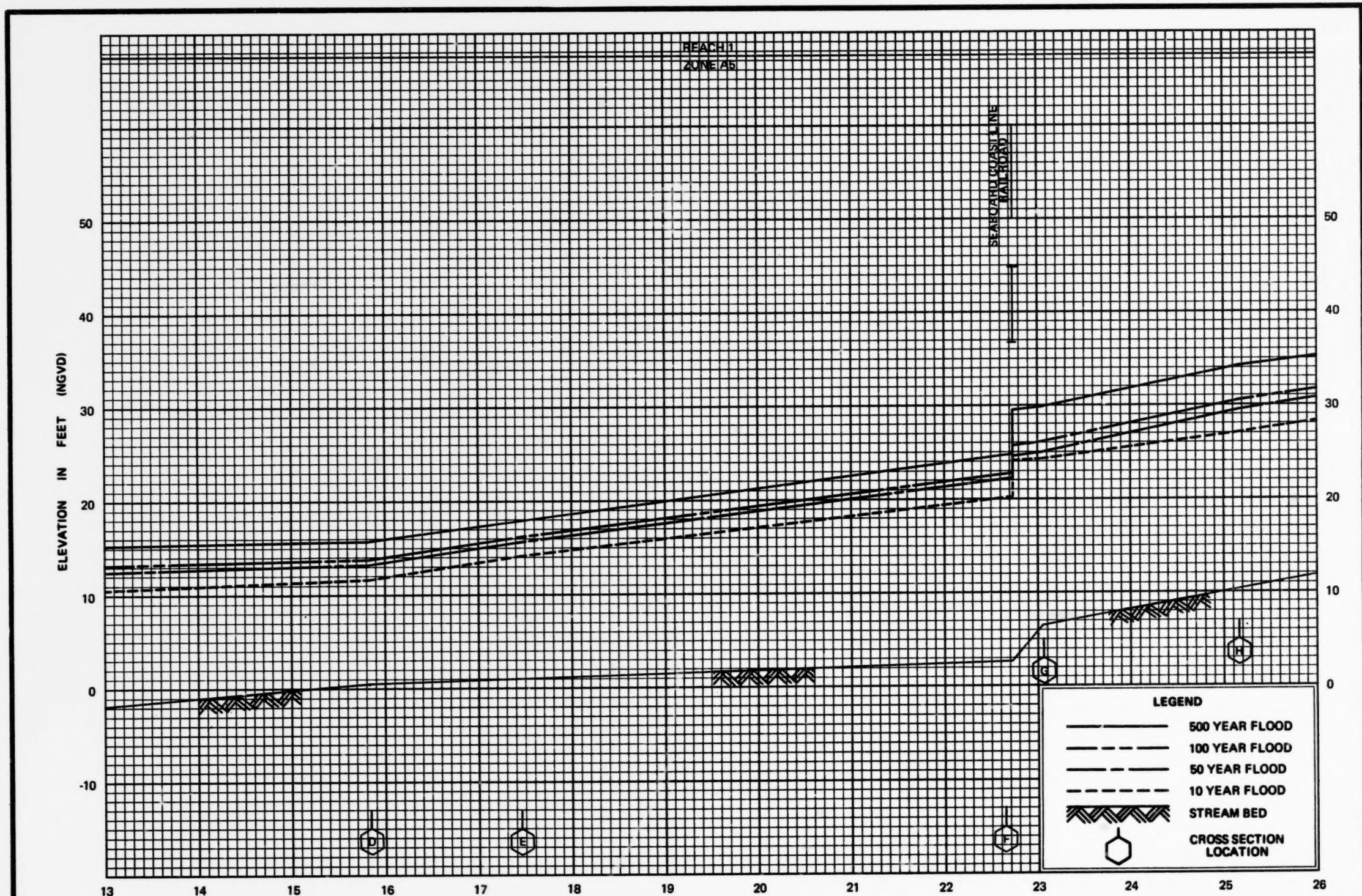
CITY OF COLONIAL HEIGHTS, VA
(INDEPENDENT CITY)

FLOOD PROFILES

SWIFT CREEK

04P

21



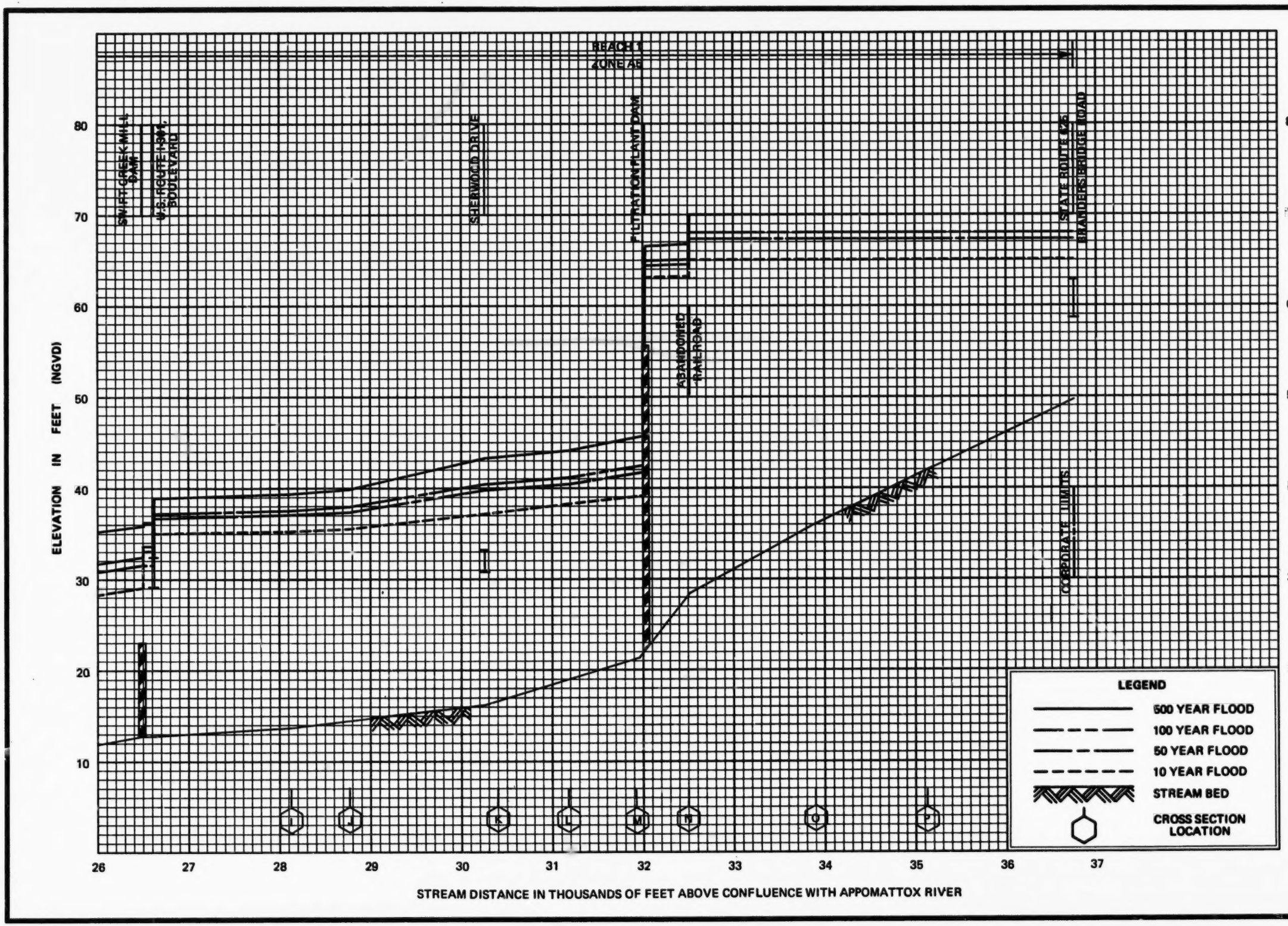
FLOOD PROFILES

SWIFT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF COLONIAL HEIGHTS, VA
(INDEPENDENT CITY)

05P



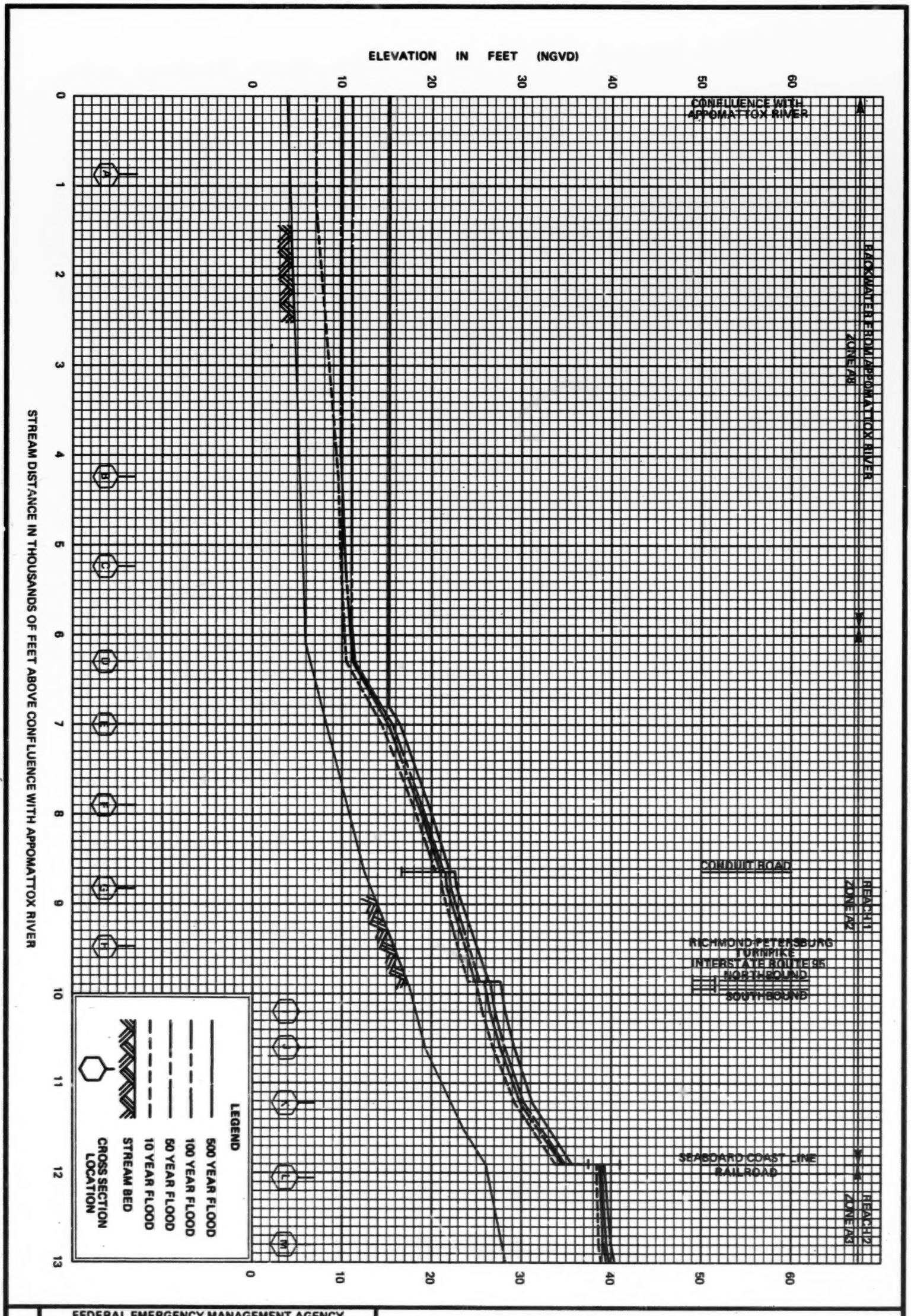
FLOOD PROFILES

SWIFT CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF COLONIAL HEIGHTS, VA
(INDEPENDENT CITY)

06P



FEDERAL EMERGENCY MANAGEMENT AGENCY

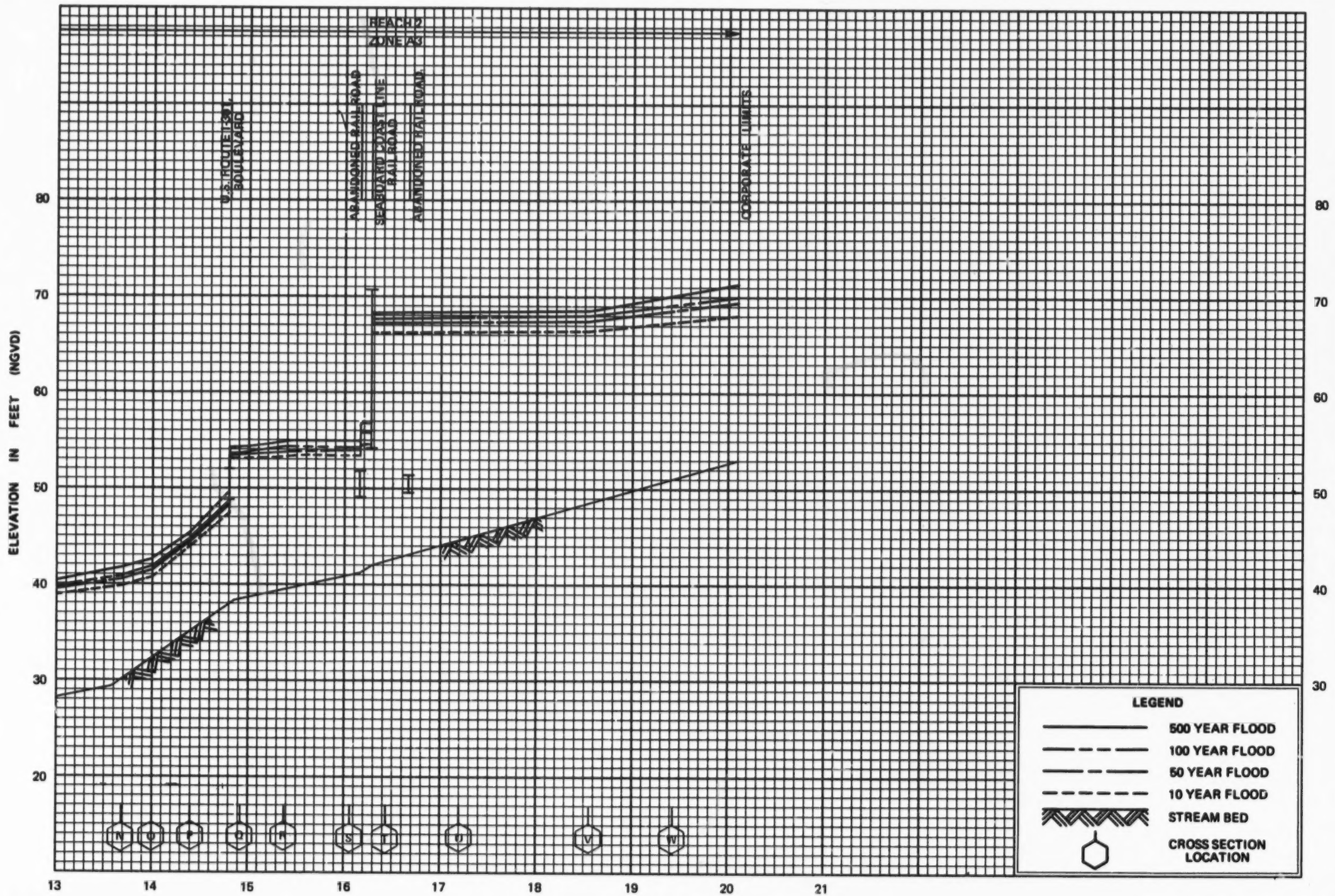
CITY OF COLONIAL HEIGHTS, VA
(INDEPENDENT CITY)

FLOOD PROFILES

OLD TOWN CREEK

07P

24



FLOOD PROFILES

OLD TOWN CREEK

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF COLONIAL HEIGHTS, VA
(INDEPENDENT CITY)

08P